ABSTRACT

A digital synthesizer generates an electrical digital carrier that is converted to analog and driven a probe coil to generate an electromagnetic wave propagated into a test material proximate the probe coil. A return electromagnetic wave generated by eddy currents in the material includes signatures of material defects modulated on the return carrier electromagnetic wave. The return wave is detected by one or more probe coils and amplified. A second amplifier is applied selectively amplifying the signal in segments such that each segment exploits the input range of the analog to digital converter. The signal is then converted from an analog signal to a digital signal and then digitally mixed with digital sine and cosine functions also generated by the digital synthesizer to yield sum and difference values. A gain scaling stage then trims the signal to overcome circuit imprecision such that the amplification in each respective segment is a power of two. A low pass filter then removes all but the difference values, leaving only the small eddy current signal. A direct current reference component is subtracted from the mixed digital signal, which translates the signal to center about a zero axis for ease of display and analysis. A bit shifter than reverses the selective signal amplification by simply shifting bits in the digital representation of the signal corresponding to the prior selective amplification.